(19) Europäisches Patentamt
European Patent Office
Office eur pé n des brevets

(11) EP 0 949 404 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.10.1999 Bulletin 1999/41

(51) Int. Cl.[6]: **F01D 9/04**

(21) Application number: **98302733.5**

(22) Date of filing: **08.04.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

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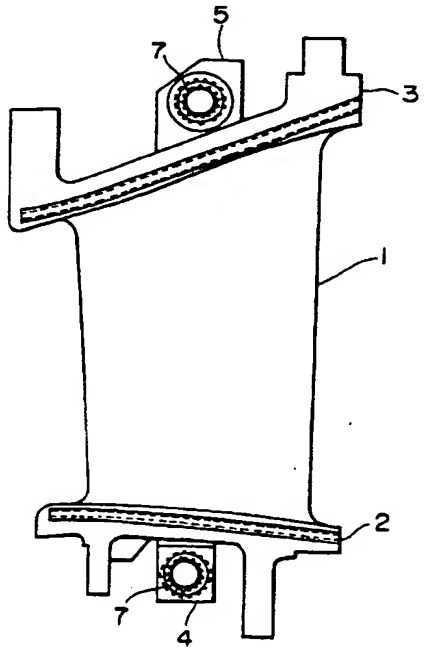
(54) Segmented cascade made from individual vanes which are bolted together

(57) The present invention provides a stationary blade of integrated segment construction, in which thermal barrier coating can be applied to the whole blade surface and an excessive stress is not produced in a shroud. A plate seat for bolt tightening is provided at each end face portion of an inside shroud and an outside shroud for a gas turbine stationary blade. Several stationary blades are integrated by joining the plate seats of the adjacent shrouds by means of bolts and nuts to provide a stationary blade of integrated segment construction.

FIG. 1



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Description

FIELD OF THE INVENTION AND RELATED ART STATEMENT

[0001] The present invention relates to a gas turbine stationary blade and, more particularly, to a gas turbine stationary blade of such a construction that thermal barrier coating (TBC) can be applied to the blade surface and a crack can be prevented from being made by a thermal stress etc. at the shroud portion.

[0002] FIG. 4 is a perspective view of a gas turbine stationary blade, and FIG. 5 is a plane cascade view. For the present gas turbine stationary blade, one inside shroud 11 and one outside shroud 12 are provided with respect to one stationary blade 1 as shown in FIG. 4.

[0003] The stationary blade 1 has a construction such that a seal plate is put between the shrouds which are adjacent to each other to supply cooling air, by which the leakage of cooling air is decreased. When a single blade construction, in which blades are divided separately, is used because of the need for applying thermal barrier coating to the blade surface, the number of portions where the seal plate is inserted increases, resulting in increased leakage of cooling air.

[0004] Also, in order to decrease the leakage of cooling air, several stationary blades are one-piece cast as an integrated segment, or singly cast blades are joined by welds into an integrated segment. In this case, however, thermal barrier coating cannot be applied to the whole surface of blade.

[0005] As described above, the decrease in leakage of cooling air caused by blade division is prevented conventionally by one-piece casting the stationary blades as an integrated segment or by welding singly cast blades into an integrated segment. However, if singly cast blades are welded into an integrated segment, a high thermal stress cannot be allowed to escape by the temperature difference between the dorsal side and ventral side of blade, so that a crack develops in the shroud.

[0006] With the recent increase in the gas turbine inlet temperature, thermal barrier coating etc. are applied to the blade surface by spraying using a coating gun to reduce the thermal load of blade surface to the utmost. In this case, if stationary blades are one-piece cast or singly cast blades are welded into an integrated segment, the coating gun does not enter a curvedly formed space between the blades, so that coating cannot be applied to the whole blade surface.

OBJECT AND SUMMARY OF THE INVENTION

[0007] The present invention was made to solve the above problems. Accordingly, an object of the present invention is to provide a gas turbine stationary blade of integrated segment construction, in which thermal barrier coating can be applied to the whole blade surface and an excessive stress is not produced in a shroud, and a manufacturing method therefor.

[0008] To achieve the above object, a plate seat for bolt tightening is provided at each end face portion of an inside shroud and an outside shroud for a gas turbine stationary blade, and several stationary blades are integrated by joining the plate seats of the adjacent shrouds by means of bolts and nuts.

[0009] In the stationary blade of integrated segment construction in accordance with the present invention, it is preferable that thermal barrier coating be applied to the whole surface of stationary blade to reduce thermal load on the stationary blade surface.

[0010] To manufacture the above-mentioned stationary blade of integrated segment construction in accordance with the present invention, after thermal barrier coating is applied to a single stationary blade, several stationary blades are integrated by joining plate seats by means of bolts and nuts. Thereby, a stationary blade to the whole surface of which thermal barrier coating is applied can be manufactured easily.

[0011] By employing the stationary blade of integrated segment construction in accordance with the present invention, the number of seals inserted between the blades can be decreased, so that the leakage of cooling air can be reduced, whereby the performance of gas turbine is improved.

[0012] When an excessive force is applied to the stationary blade of the present invention, a relative slide occurs at the tightening face of bolted plate seat etc., by which an excessive stress created at the shroud portion can be prevented. Also, because the stationary blades can easily be disassembled into a single blade by removing the bolts, a coating gun reaches the whole area, so that the whole blade surface can be coated.

[0013] As described above, in the gas turbine stationary blade in accordance with the present invention, the plate seat for bolt tightening is provided at each end face portion of the inside shroud and the outside shroud for the gas turbine stationary blade, and several stationary blades are integrated by joining the plate seats of the adjacent shrouds by means of bolts and nuts.

[0014] According to the mechanically joined stationary blade of integrated segment construction in accordance with the present invention, since the number of portions where a seal is inserted can be decreased by making several stationary blades an integrated segment, the leakage of cooling air can further be reduced, whereby the performance of gas turbine can be improved.

[0015] Also, for the stationary blade in accordance with the present invention, since thermal barrier coating can be applied to the whole blade surface by performing the thermal barrier coating operation before joining the plate seats by means of bolts and nuts, the thermal load on the blade can be reduced, so that a higher temperature of gas turbine can be overcome.

[0016] Further, since the thermal deformation caused by the temperature difference between the dorsal side

and ventral side of blade can be absorbed by the relative slide on the bolted faces, an excessive stress created in the shroud can be prevented, so that the reliability of blade is increased.

[0017] As described above, the present invention achieves large effects contributing to increased reliability and performance of gas turbine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is an elevation showing a stationary blade of integrated segment construction in accordance with one embodiment of the present invention;
FIG. 2 is a plan view of the stationary blade of integrated segment construction shown in FIG. 1;
FIG. 3 is a sectional view taken along the line B-B of FIG. 2, showing a bolt tightening portion;
FIG. 4 is a perspective view showing a construction of a conventional gas turbine stationary blade; and
FIG. 5 is a plane cascade view for the conventional gas turbine stationary blade.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0019] One embodiment of the present invention will be described in detail with reference to the accompanying drawings. In FIGS. 1 to 3, reference numeral 1 denotes a stationary blade, 2 denotes an inside shroud, and 3 denotes an outside shroud. The stationary blade 1 is provided between the shrouds 2 and 3. At each end of the inside shroud 2 and outside shroud 3 for the stationary blade 1, plate seats 4 and 5 for bolt tightening are erected, respectively. These plate seats 4 and 5 each are formed with a bolt hole for inserting a bolt 6. As shown in FIG. 2, the plate seats 4 and 5 of the adjacent shrouds 2 and 3 are joined mechanically by means of the bolts 6 and nuts 7, by which several single blades are joined into an integrated segment.

[0020] Thus, several stationary blades 1 are integrated to form an integrated segment. By using this construction, when an excessive force due to a thermal stress is applied, a relative slide occurs on the tightening faces A of the plate seats 4 and 5 and shrouds 2 and 3, by which an excessive stress created at the shroud portion can be prevented. Also, the whole surface of blade can be coated because the blades can easily be disassembled into a single blade by removing the bolts 6.

[0021] That is, the stationary blade of integrated segment construction can be obtained by integrating several stationary blades 1 by joining the plate seats 4 and 5 of the adjacent shrouds 2 and 3 by means of the bolts 6 and nuts 7 after thermal barrier coating is applied to a single stationary blade 1.

[0022] In this specification the terms 'radial' and 'axial' are used with reference to the longitudinal shaft axis of a gas turbine engine.

Claims

1. A stationary blade of integrated segment construction, in which a plate seat for bolt tightening is provided at each end face portion of an inside shroud and an outside shroud for a gas turbine stationary blade, and several stationary blades are integrated by joining said plate seats of the adjacent shrouds by means of bolts and nuts.

2. A stationary blade of integrated segment construction according to claim 1, wherein thermal barrier coating is applied to the whole surface of said stationary blade.

3. A manufacturing method for a stationary blade of integrated segment construction, in which after thermal barrier coating is applied to a single stationary blade, several stationary blades are integrated by joining plate seats for bolt tightening provided at each end face portion of an inside shroud and an outside shroud by means of bolts and nuts.

4. A stationary blade for a gas turbine engine, the blade being of integrated segment construction and comprising a blade portion having an inside shroud member at a radially inner end and an outside shroud member at a radially outer end thereof; the inside and outside shroud members having generally axially directed faces which align with the corresponding faces of adjacent stationary blade shroud members to form an integrated segment, the stationary blade being characterised by having plate seat members adjacent said generally axially directed shroud faces, said plate seat members of adjacent blades being fixable together to form an integrated segment.

5. A stationary blade according to claim 4 wherein adjacent blades are fixed together with bolts and nuts passing through apertures in the plate seat members.

6. A stationery blade according to either claim 4 or claim 5 wherein the plate seat members permit relative movement between adjacent blades under stress.

FIG. 1

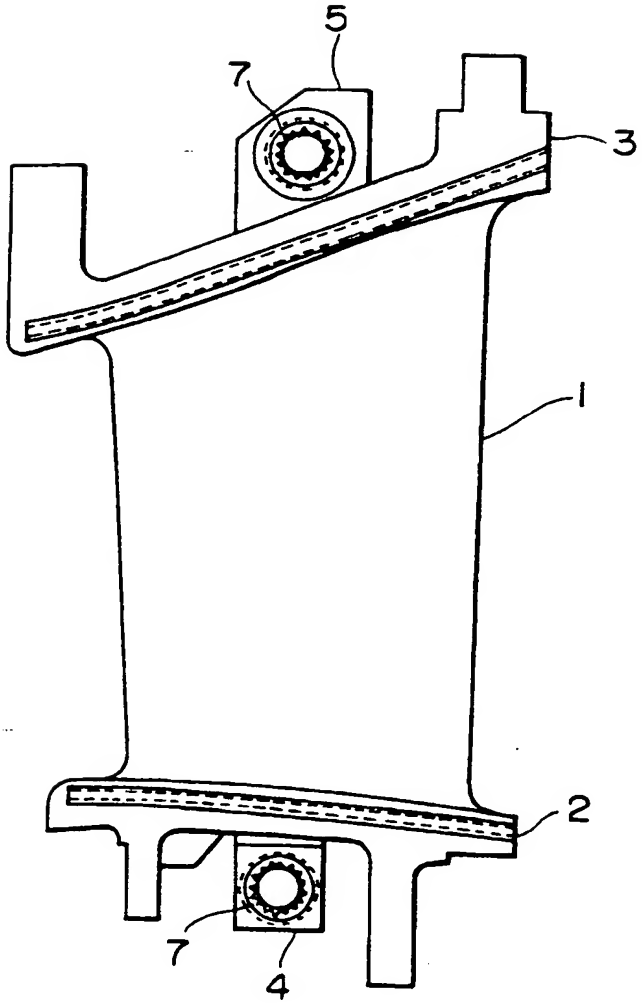


FIG. 2

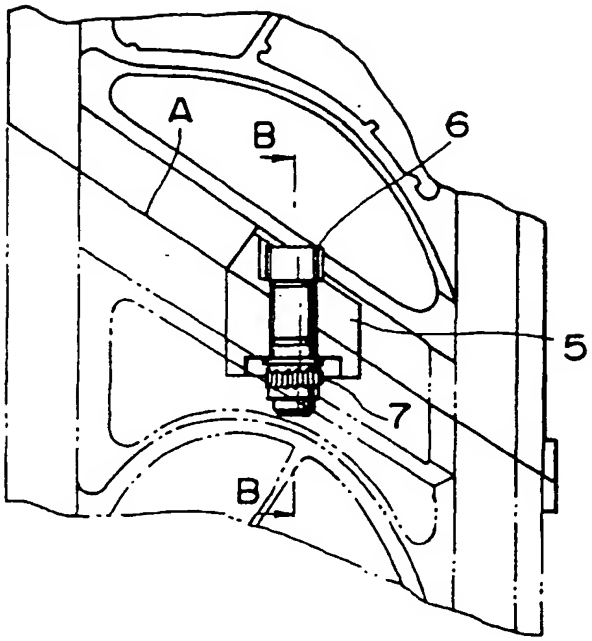


FIG. 3

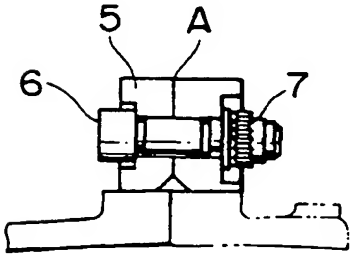


FIG. 4

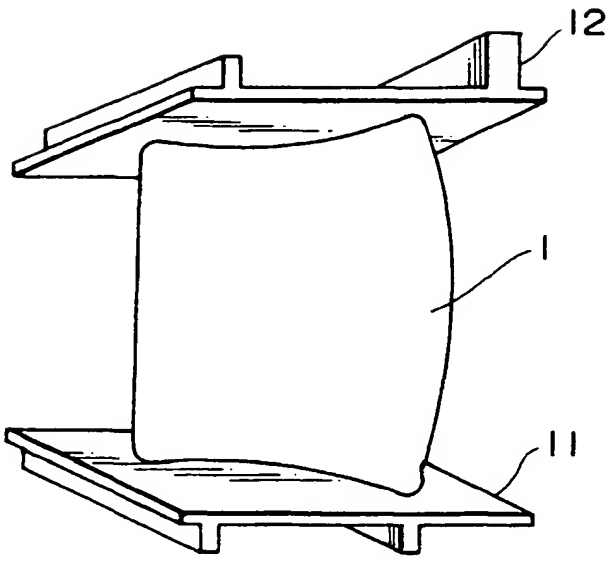
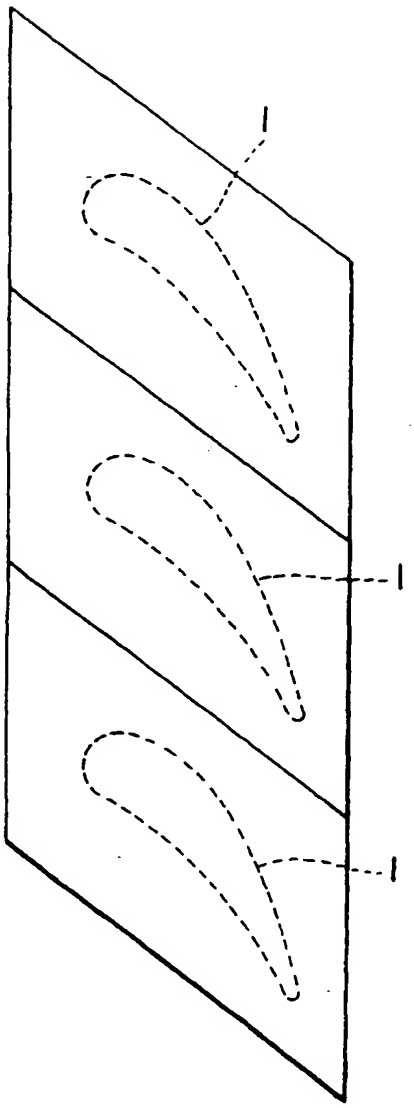


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 2733

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 015 910 A (HARMON KENNETH E ET AL) 5 April 1977 * column 1, line 12 - column 2, line 55; figures 6-8 *	1-6	F01D9/04
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F01D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 September 1998	Iverus, D

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)